Transportation System

Affected Environment:

The existing transportation system was inventoried and reviewed in 2002. Timber to be accessed within the proposed sale areas will utilize existing transportation facilities with improvements and require construction and reconstruction.

Existing Condition:

Table 34 displays the types of roads and the jurisdiction of the roads for the project area.

Table 1 Existing Transportation System

Type	Miles
Federal Highway	11.4
County	12.4
Arterial	0.0
Collector	8.7
Local	157.3
SUB-TOTAL	189.8
Non-System Roads	70.5
TOTAL	260.3
Density	3.4

Open/ Closed Roads

Table 35 displays the percentage of open and closed roads in the project area.

Table 2 Road Management

Open Year Long	Open Seasonally	Closed Year long	Decommissioned
43%	45%	12%	0%

Non-System roads not needed for management or other uses will be obliterated or decommissioned as the opportunity arises. Road obliteration will consist of one or more of the following: Ripping, Seeding, Water barring, Slashing, Removal, or Blocking.

The area is considered open for travel except for areas with yearlong closures for wildlife and seasonal closures for soft roadbed conditions. At present there are a number of road closures located throughout the area. The current Road Management Objectives (*RMOW*) for the remaining system roads have no closures.

Rights-Of-Ways:

The Forest Service has no Rights-Of-Way for the following listed areas:

Table 3 No Forest Service Right-Of-Way

Alternative No.	Road Number	Approximate Length	Legal Description
2,3,4	U030024	0.2	T.5N., R.4E. Section 18
2,3,4	U030025	1.0	T.5N., R.4E. Section 18
2,3,4	5	0.2	T.5N., R.4E. Section 17
2,4	U080088	0.1	T.4N., R.4E. Section 27
2,3,4	U030031	0.1	T.5N., R.4E. Section 4

Environmental Consequences:

Alternative 1

Alternative 1 'No Action': Will have no effect on the present condition because no additional roads will be constructed, reconstructed or decommissioned within the area. Existing roads that have "Best Management Practices" (BMP's) violations will be addressed during specified maintenance, as funding is available.

Action Alternatives 2,3, and 4

Depending on the alternative, access to the proposed treatment areas will require approximately 34.5 to 42.5 miles of road construction or reconstruction, which will potentially have the following effects:

1. Improve vehicle access to the area.
2. Increase road maintenance needs and costs.

Table 4 Proposed Transportation Activities by Alternative

Alternative	New Road Construction	Road Reconstruction	Decommission
2	16.2	26.3	60.7
3	11.5	23.0	62.0
4	16.2	26.3	55.9

A more detailed listing of effects may be found in the environmental consequences sections in Chapter 3 for the various resources affected by the proposed transportation activities. Additional measures will be implemented to minimize impacts using "Engineering Design Guidelines" & "Best Management Practices."

Specific Concerns:

Some road locations will require a field review with the District Botanist to assure that sensitive plant habitat is not compromised. Refer to the mitigation section in Appendix B for the roads that the field review applies to.

Open / Closed / Road Densities by Alternatives:

Table 5 Road Density by Alternative in Miles/Square Mile

Alternative	Open Y/Long	Open Seasonally	Closed Y/Long	Decommissioned
1	1.5*	1.5	0.4	0.0
2	1.1	1.2	0.5	0.8
3	1.1	1.2	0.5	0.8
4	1.1	1.3	0.5	0.7

*Density is measured as miles of road per square mile.

Table 6 Percentage of Open and Closed Roads by Alternative

Alternative	Open Y/Long	Open Seasonally	Closed Y/Long	Decommissioned
1	43%	45%	12%	0%
2	31%	34%	14%	21%
3	31%	34%	13%	22%
4	31%	35%	15%	20%

Additional Information:

Additional maps, calculations and data that were used in preparing this analysis are available in the project file at the Northern Hills Ranger District Office, 2014 North Main Street, Spearfish, SD 57783.

Fire Hazard and Fuel Loading

Affected Environment:

Existing Fuel Condition

The composition and structure of forest vegetation as well as the arrangement of dead material within the forest are major factors in influencing the frequency and intensity of wildfire activity.

The Elk Bugs and Fuels project area has five forest cover types: ponderosa pine, aspen, white spruce, other hardwoods, and three non-forest cover types: grass, rock, and non-forest. Ponderosa pine is, by far, the most common cover type on the project area.

Stands vary from pure ponderosa pine on drier sites, to ponderosa pine mixed with white spruce, quaking aspen, paper birch, bur oak, and/or hophornbeam, locally known as ironwood. Drainage bottoms have eastern hophornbeam and bur oak on the lower elevation sites. White spruce, quaking aspen, and paper birch are common in north aspect ponderosa pine stands. Much of the ponderosa pine cover type regenerated in the late 1800s or early 1900s after heavy logging, bug epidemics and/or wildfires. Stands are predominately even-aged, with remnant over-mature trees that survived wildfires, insect infestations and logging.

Snowstorms in the fall of 1998, and spring of 1999 caused considerable damage and mortality in some of the ponderosa pine stands throughout the northeastern Black Hills. The area impacted by the blow down is highly variable in terms of size of the impacted area (Beaver Park fire management plan). These areas have higher concentrations of both hazardous fuels (<3”) and large diameter fuels (3” plus).

The Beaver Park area and vicinity is currently experiencing a mountain pine beetle epidemic. The Beaver Park Roadless Area is outside the project area boundary, however this project area is adjacent to it on the north, west, and south sides. Beetles are starting to move out into surrounding Forest lands in the area. Locations such as Vanocker Canyon, Park Creek, and Elk Creek Canyon are becoming heavily infested (Allen et al.). Beetle caused mortality is occurring on National Forest and lands of other ownership. The existence of pine beetles does not lead to large stand replacing fires, large tracts of dead trees, can however. Crown fuels will ignite when the heat from a surface fire raises crown fuels to ignition temperature (Van Wagner 1977). Moisture must first be driven off from any fuel before it can be ignited. Fine dead fuels can reach moisture levels as low as 3-4%. Live fuel moisture (green needles) for ponderosa pine in the black hills is considered low when they are 80 to 90%. When moisture that needs to be evaporated from fuels is less, it will take less heat for a fire to ignite and spread through those fuels. In this situation, rates of spread will be faster and flame lengths will be higher. In addition, fires burning in areas of heavy downed fuels are more resistant to control because they produce higher energy releases (intensity) over longer periods of time and slow the construction of firelines. (Agee et al. 1993)

This mortality has created, and continues to create, large amounts of dried fuels. These fuels consist of both the fine fuels that are used to predict fire behavior and spread, and the large diameter fuels that can increase resistance to control and increase fire severity. The vertically oriented dried pine needles from bug-killed trees ignite much more readily than those on green trees. The problem is compounded because the dense stands that are most likely to be attacked by beetles are generally sufficiently dense enough to sustain an active crown fire. Once the needles fall off of the beetle killed trees, the situation becomes less hazardous, however the stand will still contain large amounts of fuel that when dry, will burn intensely and be difficult to control due to the increased heat production, spotting from snags, and significant reduction in fire line production. Assuming near 100 percent mortality in these areas, once the dead trees have fallen, hand crews will not be effective in containing the fire in this situation. According to National Wildfire Coordination Group fireline handbook, fire line production rates for dozers in heavy fuels such as these are approximately 25 to 50 percent of what can be constructed in grass/pine litter types commonly found in the black hills.

Table 7–Predicted fire behavior comparison in bug-killed trees with red needles attached, and after the dead trees have fallen.

	Bug Killed Foliage	Green tree	Bug killed Heavy down
Surface fuel model	9	9	13
Type of fire	Active crown	Surface	Surface
Crown fraction burned	100	0	No crowns
Rate of spread	151ch/hr	10 ch/hr	22 ch/hr
Flame length	74 ft.	3 ft.	12 ft.
Perimeter growth rate	350 Ch	27 Ch	55 Ch
Fire area	717 Ac	5 Ac	18 Ac
Spread distance	151 chains	10 chains	22 chains
Potential crown fire ROS	151ch/hr	57ch/hr	No crowns
CROWN FIRE HAZARD INDICES			
Torching Index	15mph	26mph	No crowns

Crowning Index	13mph	28mph	No crowns

Fire Regime

The November 2000 Forest Service report Protecting people and Sustaining Resources in Fire-adapted Ecosystems- a Cohesive Strategy, classifies fire-adapted ecosystems by fire regime group and condition class. Such groups are useful to catalog fire and ecological information. This direction is part of the national fire plan policy, to which fuels management projects are tied. This system is based upon the effects of fires on dominant vegetation, from low to high severity. More than all others, this type of system recognizes the variability in fire that occurs within or between fires on a site (Agee 1993).

Fire Regime Descriptors

Five combinations of fire frequency, expressed as fire return interval and fire severity, are defined in Table 41. Groups I and II include fire return intervals in the 0-35 year range. Group I includes ponderosa pine, other long-needle pine species, and dry-site Douglas fir. Group II includes the drier grassland types, tall grass prairie, and some chaparral ecosystems. Groups III and IV include fire return intervals in the 35-100+ year range; and Group V is the long-interval (infrequent), stand replacement fire regime.

Table 8 – The Five Historic Natural Fire Regime Groups.

Fire Regime Group	Frequency (Fire Return Interval)	Severity
I	0-35 years	Low severity
II	0-35 years	Stand replacement severity
III	35-100+ year	Mixed severity
IV	35-100+ year	Stand replacement severity
V	>200 years	Stand replacement severity

Fire Regime Groups I and II
These regimes occupy nearly all the lower elevation zones across the U.S. They have been most affected by the presence of human intervention and analysis shows that these types demonstrate the most significant departure from historical levels. The departures

are affected largely by housing development, agriculture, grazing, aggressive fire suppression, and logging. These areas are at greatest risk to loss of highly valued resources, commodity interests, and human health and safety. The Ponderosa Pine communities of the Black Hills are classic Fire regime 1.

Fire Regime Group III

Fires of different severities created a mosaic of stand structure, age, density, species composition, and fuel loading across the landscape. The mosaics tended to be more distinct as the fire effects are more pronounced in these fire regimes. Fires that burned in this fire regime created more diversity across the landscape with patches created by mixes of mortality and unburned or underburned areas ranging in size from less than 1 acre to 25,000 acres of different densities and compositions. Aspen stands most often burn on a cycle somewhat similar to their surrounding vegetation, although in the case of ponderosa pine, there were probably times when pine stands burned, but due to their more mesic nature, Aspen stands did not. During drought periods and extreme wind events these aspen stands would burn, but with differing intensities from the surrounding vegetation. Aspen and other deciduous tree stands within the project area are considered to be in fire regime III.

Current Condition Class Attributes

The condition class is used to categorize the current condition with respect to each of the five historic Fire Regime Groups. The National Fire Plan strategy uses condition class descriptors to identify risk conditions. Three Condition Classes have been developed to categorize the current condition with respect to each of the five historic Fire Regime Groups. Current condition is defined in terms of departure from the historic fire regime, as determined by the number of missed fire return intervals – with respect to the historic fire return and the current structure and composition of the system resulting from alterations to the disturbance regime. The relative risk of fire-caused losses of key components that define the system increases for each respectively higher numbered condition class, with the least risk at the Class 1 level.

Table 9 Condition Class descriptions

Condition Class[1] descriptions		
Condition Class	Fire Regime	Example Management Options
Condition Class 1	Fire regimes are within an historical range and the risk of losing key ecosystem components is low. Vegetation attributes (species composition and structure) are intact and functioning within an historical range.	Where appropriate, these areas can be maintained within the historical fire regime by treatments such as fire use.
Condition Class 2	Fire regimes have been moderately altered from their historical range. The risk of losing key ecosystem components is moderate. Fire frequencies have departed from historical frequencies by one or more return intervals (either increased or decreased). This results in moderate changes to one or more of the following: fire size, intensity and severity, and landscape patterns. Vegetation attributes have been moderately altered from their historical range.	Where appropriate, these areas may need moderate levels of restoration treatments, such as fire use and hand or mechanical treatments, to be restored to the historical fire regime.
Condition Class 3	Fire regimes have been significantly altered from their historical range. The risk of losing key ecosystem components is high. Fire frequencies have departed from historical frequencies by multiple return intervals. This results in dramatic changes to one or more of the following: fire size, intensity, severity, and landscape patterns. Vegetation attributes have been significantly altered from their historical range.	Where appropriate, these areas may need high levels of restoration treatments, such as hand or mechanical treatments, before fire can be used to restore the historical fire regime.
[1]Current conditions are a function of the degree of departure from historical fire regimes resulting in alterations of key ecosystem components such as species composition, structural stage, stand age, and canopy closure.		

Fires in Condition Class 1 are thought to be low-intensity, low-severity burns that leave the soil intact and functioning normally. These fires generally pose little risk and have positive effects to biodiversity, soil productivity, and water quality.

Condition Class 2 situations develop as one or more fire return intervals are missed, primarily due to well-intentioned suppression efforts, while understory vegetation continues to grow, becoming denser. If this accumulating vegetation is not treated, fires begin to burn more intense -- making them more difficult to suppress. The impact of fires to biodiversity, soil productivity and water quality become more pronounced.

In Condition Class 3, fires are relatively high risk. The forest is littered with considerable amounts of dead material and is choked with hundreds of small trees that reach into the crowns of the larger, older-age forest above. During drought years, small trees and other vegetation dry out and burn along with the dead material – fueling severe, high intensity wildland fires. At these intensities, wildland fires kill all of the trees – even the large ones that, at lower fire intensities, would normally survive. Condition Class 3 is classified as high risk because of the danger it poses to people and the severe, long-lasting impacts likely to result to species and watersheds when a fire burns – particularly in drought years.

The Black Hills Ponderosa Pine Forest is recognized as classic Fire Regime 1. There are ample historic examples of the relatively frequent, low intensity fires and the resulting vegetative structure. Historically, a given acre of forest would have burned every 10 to 40 years (Black Hills National Forest Fire Management Plan, 2002). With the shortest return intervals on the dryer pine sites. The Elk Bugs and Fuel area is dominated by Ponderosa Pine sites, although there are stands that are classified as aspen, grass and white spruce. There are other deciduous trees that occur in small clumps or as an understory component in pine stands, but for purposes of fire regime type, the dominant covertype will be used.

A Recent paper by Shinneman and Baker (1996) proposes that large, stand replacing fires were an integral part of the Black hills ponderosa pine forest. Considerable information exists for fire history and ecology of ponderosa pine communities. The overwhelming body of evidence is that the frequency of fire in these areas was sufficient to control the fuels and vegetative structure in such a way that large, stand-replacing fires would be quite rare. Biswell et al. (1973) considered crown fires in ponderosa pine to be exceptionally rare. However, even in low severity fire regimes, intense fires may sometimes occur, possibly due to longer than normal fire-return intervals that allow litter and understory fuels to build up, or due to very unusual fire weather (Agee 1993). Large blocks of even-aged stands are unusual in ponderosa pine forests, but do occur (Agee 1993).

It does appear that stand replacing fires may have been an infrequent part of the fire regime in the Black Hills. In most instances however, frequent fire will act as a natural thinning agent (Wright and Bailey 1982) to keep fuel conditions from reaching a level where crown fires are likely. Surface fires helped to kill the younger, weaker trees and dense thickets in a young pine stand, as a result competition and stand stagnation were minimized. Nutrients in the litter were recycled (Vlamis et al. 1955, Moir 1966, Wollum and Schubert 1975). Lower branches and foliage of the remaining small trees were pruned and thinned (Biswell et al 1973). Repeated fires permitted the development of mature ponderosa pines with expanded canopies, sometimes nearly closed (Wright and Bailey 1982). Other than the few fire history studies done in the black hills area, most historical data is qualitative rather than quantitative, which presents an opportunity for speculation. Historical observations of relatively dense canopies could be misinterpreted to mean small diameter stands with high trees per acre. Shinneman and Baker appear to make this mistake in their paper, reporting POL sized trees by modern standards (6-10" trees) when referring to graves report, where he referred to trees that were 10-14". Baker and Ehle (2001) propose that for regeneration of ponderosa pine to be successful, a fire free interval of 50 years would be required. This theory is based upon the assumption that a fire would kill almost all seedlings up to 6' in any season. They also assume that in order to survive, a small tree must have experienced the necessary fire-free interval. However they also point out that during a surface fire, not all areas within the perimeter will burn, although they did not define this spatially or in relation to fire size. They acknowledge that even some of the small (<6 feet) trees would have survived, which coincides with the theory that most ponderosa pine stands were multi-aged, but often approximately the same size. They also assume that fires would not scar trees greater than 150 years old, although often times older trees have repeated scars. While most attempts at classifying a ponderosa pine forest focus on what is "typical" it probably rarely exists, however various successional stages can be found in forests, as well as variations of the successional phases (Wright and Bailey 1982).

The composition and structure of forest vegetation as well as the arrangement of dead material within the forest are major factors influencing the frequency and intensity of wildfire activity. There is evidence that fire incidence in the Black hills may have included both low to moderate intensity surface fires and stand-replacing fires. Brown and Siegs study notes a reduction of fire scar dates at the end of the 19th century, which follows patterns of other fire history studies that are thought to be the result of non-native settlement activities. Post-settlement changes in ponderosa pine have been documented in numerous studies. These studies are not limited in geographic location, but are scattered throughout the western U.S. For instance (Gruell et al 1982) in Montana, (Weaver 1959) in Washington, (Madany and West 1983), (Stein 1987) in Utah, (Laudenslayer et al. 1989) in California, and (Barrett 1988), (Steel et al. 1988) in Idaho, all suggest that increased fuel loading, tree density and crown fire occurrence are common results of fire exclusion in ponderosa pine communities.

While areas of dense trees may have existed, they would typically be separated spatially. The coalescing of these patches into larger and larger areas capable of supporting very large crown fires since settlement represents a shift from a low to moderate intensity to one of high intensity (Covington and Moore 1992). Long fire free intervals (40 years) although possible, would be rare due to the climate and prolific regeneration that the black hills is known for. Fires occur every year in the Black hills, even in wet years. Without suppression forces to extinguish these fires, they could possibly burn for days or weeks. While spread rates may be low under wet conditions, the resulting spread over such long periods could result in large areas burned, but not at crown fire intensities. While crown fires likely occurred historically in the Black hills, they would have been quite rare compared to the more frequent, low intensity burns that occurred on a yearly basis. Fire regimes are based upon dominant fire factors such as intensity, rate of spread, and severity, therefore ponderosa pine in the black hills should be classified as a short return, low intensity fire regime.

Fires of light intensity can leave sufficient organic matter on the ground surface so that the surface is protected. Severe fires such as crown fires will consume the duff and litter layer, kill much of the vegetation, and often create hydrophobic (water-repelling) soil conditions. These effects, and the potential risk to developed property, values such as timber and recreation, and the possible threat to firefighter and public safety justify fuel treatment in fire regimes that typically had short return, low intensity fires.

Condition class is a useful attribute, but must be used carefully when applied to managed forests such as the Black Hills. Prior to 2002, recorded large fire activity in the project area has been limited to the Lost Gulch fire in 1931, (400 ac) the Big Elk fire in 1949, (1576 ac), the Deadwood fire in 1959 (4547 ac), and the Pine fire in 1983 (132 ac). Only a small percentage of the Deadwood fire burned in the project area, and approximately 85 percent of the big elk fire burned in the project area. There have also been numerous small fires that were quickly extinguished by aggressive suppression tactics. Most of the stands within the analysis area have not had fire in them for a significant length of time.

In 2002, two large fires burned in the vicinity of the project area. The Grizzly Gulch Fire burned 11,589 acres. Almost half of the fire, 5,608 acres, burned within the Elk Bugs and Fuels project boundary; 3,025 acres of National Forest system lands and 2,583 acres of other ownership. National Forest system lands within the project area that burned were mostly forest vegetation, with ponderosa pine, aspen, or aspen-birch cover types. Mortality of trees on National Forest system lands within the project area was mostly low to moderate, with high mortality on approximately 240 acres. The Little Elk fire burned approximately 484 acres of private and national forest system lands just outside of the project boundary to the Southeast.

The Black Hills Land and Resource Management Plan identifies fire hazard ratings at the stand level for conifers using a matrix of stand structure and slope. These ratings were compared to the parameters for condition class and were determined to be logical fit given the available information. The translation from fire hazard to condition class can be made for a low severity, high frequency fire regime because the changes that occur in condition class for these systems are the result of changing fire hazard. This type of translation may not be appropriate for other regimes such as low frequency, high severity regimes. For the purposes of this project, stands that would be rated as high in hazard using the matrix in the forest plan were assigned to condition class 3. Those rating medium in hazard were assigned condition class 2, and those rating as low were assigned condition class 1. For the Elk Bugs and fuels area, this means that within conifer stands, approximately 20,599 acres are in condition class 3, 11,925 acres are in condition class 2, and 9413 acres are in condition class 1. The deciduous stands are being encroached by conifers and are at the high end of condition class 2.

Hazard, Values and Risk

Fire Management Direction

The Elk Bugs and Fuels project area lies within the Spearfish Canyon, Bethlehem and Custer Peak compartments of the Black Hills Workload and Prevention Workload analysis. Each of the compartments for the forest are rated individually for hazard, values, and risk. For the Purposes of the analysis Hazard is defined as the fuels and topography of the area, Values are natural or developed areas where loss or destruction by wildfire would be unacceptable, and Risks are human uses which have the potential to result in a wildfire ignition. The Spearfish compartment is rated as “high” in all three categories. The Custer Peak compartment is rated “high” in risk and value, and moderate in Hazard. The elk creek compartment is rated moderate in risk, high in hazard, and moderate in values. The Bethlehem compartment is rated high in risk and hazard, and moderate in values. Once the Risks, Hazards and Values are evaluated, it is possible to determine how vegetation management activities, or the lack thereof, affect the surrounding environment.

Fire Hazard Assessment

The 1995 Federal Wildland fire Management Policy identified guiding principals that are fundamental to wildland fire management. The first and most important guiding principal with in the report identifies firefighter and public safety as the number one priority in every fire management activity. The most significant factor for fire management is fuel hazard. Fuel hazard, based on forest composition and structure is the single most controllable. A wildfire hazard assessment should analyze crown fires as well as surface fire. Crown fires are normally the most destructive, difficult to control, and present the biggest safety hazard to firefighters and the public. Therefore the emphasis of fuel management should be to manage the factors that contribute to the initiation and spread of crown fires. In general, crown fires burn hotter and result in more severe effects than surface fires. For example, rains following the 2002 Grizzly Gulch fire resulted in mudslides that entered the town of deadwood. There are no known instances of a similar occurrence in the black hills due to a cooler burning surface fire. Historically speaking, a typical fire in ponderosa pine forests had little effect on the herbaceous component besides removing the cured material above the ground (Agee 1993). Crown fire rate of spread is at least 2-4 times as fast as surface fires (Rothermel 1983). Fires that spread at a significantly greater speed and with higher intensities pose a greater risk to firefighters and the public. Agee (1996) describes two ways of managing crown fire potential: prevention of conditions that initiate crown fire, and prevention of conditions that allow a crown fire to spread. There are three main factors that contribute to crown fire behavior that can be addressed through fuels management. They are initial surface fire behavior, canopy base height, and canopy bulk density.

Forty-six percent (20,599 acres) of the project area's stands are rated as high fuel hazard using the methodology in the Forest Plan EIS. Approximately 11,925 acres are rated as medium hazard (26 percent), and 28 percent, or 12,242 acres of the total project stands are rated as low in fire hazard. In addition there is approximately 15,605 acres of other ownership within the project boundary.

Surface Fuels

Ponderosa Pine is the most prevalent covertype, although, it is sometimes mixed with other species such as white spruce and various deciduous tree types. Within the project boundary these pockets of deciduous trees contain Aspen, Birch and Ironwood. Surface fuels vary from sites with low to moderate natural fuel load of needles, grass and woody ground fuels to isolated sites with heavy ground fuels which are the result of broken tree tops from storm damage. Grass with some downed woody material is the dominant ground vegetation in most sites, with needlecast and Juniper mixed in throughout the project area.

Surface fuels are an important factor in determining how fast a surface fire will spread (rate of spread), and how hot it will burn (flame length). These surface fire factors are also important to the initiation and spread of a crown fire, which tends to be the more destructive and difficult to control than a surface fire. Surface fuel loading consists of needles, leaves, grass, forbs, dead and down branches and boles, stumps, shrubs, and short trees. Within the project area surface fuel loading is generally fairly light, ranging from 2-3 tons/acre in stands with mostly grass understory, with up to 10 tons/acre in areas with Juniper and downed woody material. Areas with broken tops due to storm damage have additional fuel loading ranging from 3-15 tons per acre on top of the preexisting natural fuels (Beaver Park fire Management Plan, in development). Fuel models within the project area are 2 (grass), 9 (timber litter), 10 (Litter and shrub) and 11 (slash or woody debris).

Potential fire size may exceed the less than 5-acre suppression objective for project areas within Management Area 5.1 and 5.2A. Suppression objectives can be met for all other Management areas in the project when a surface fire occurs. The suppression objective will not be met in any of the areas when a crown fire occurs. Fires spreading in beetle-killed trees with red needles attached spread very rapidly, and are not likely to be contained even with very aggressive suppression action.

Table 10 Suppression objectives by management area, with predicted size of fire in 1 hour.

Management Area	Acres	Suppression Objective	Surface fire size, 1 hour	Crown fire size, 1 hour	Beetle killed trees, fire size, 1 hour
3.31	426	<10 Ac.	4 Ac	113 Ac	717 Ac
3.32	1,644	<10 Ac.	4 Ac	113 Ac	717 Ac
5.1	11,604	<5 Ac.	4 Ac	113 Ac	717 Ac
5.2A	3,299	<5 Ac.	4 Ac	113 Ac	717 Ac
5.4	27,793	<15 Ac.	4 Ac	113 Ac	717 Ac

Canopy Base Height

Canopy Base Height (CBH) is the lowest height above the ground at which there is a sufficient amount of canopy fuel to propagate fire vertically into the canopy. Canopy base height is an effective value that incorporates ladder fuels such as shrubs and understory trees as well as the lower branches of mature trees. Canopy base height is often measured at the lowest height above ground where at least 30 lbs/ac/ft (or .010 kg/m3) of available canopy fuels is present. The lower the canopy base height, the easier it is for a given surface fire to initiate a crown fire. Low canopy base heights provide the "ladder" which allows a surface fire to become a crown fire.

Canopy Bulk Density

Canopy Bulk Density (CBD) is defined as the mass of available canopy fuel per unit canopy volume. It is a bulk property of a stand, not an individual tree. It is represented as the available canopy fuel load divided by canopy depth (Scott & Reinhard 2001). For any given species, wider spaced trees have a lower canopy bulk density, which makes it more difficult to maintain crown fires.

In order for a crown fire to initiate in a given stand, a surface fire must be intense enough to ignite the lowest level of branches that will propagate fire to the upper levels of the canopy. In order for the initiated crown fire to persist, the canopy must be dense enough for the fire to spread from one tree's branches to another tree (CBD). Stands that contain high crown bulk densities can sustain a crown fire that has initiated from outside the stand; even when surface fire intensity and CBH are such that fires that start within the stand will not transition into a crown fire.

Risk of Ignition

According to the Black Hills Wildfire Prevention Analysis, the Elk Bugs and Fuels project falls within compartments that are considered “high” in risk of ignition. The project is located within Fire Management Zone 2 (FMZ 2). There have been a few relatively small fires in the project area in the last 20 years. However, the Grizzly Gulch fire of 2002 burned approximately 11,000 acres and was immediately adjacent to and partially within the northwest portion of the project area. The fire caused the evacuation of the towns of Lead, Deadwood, and Galena, as well as several outlying subdivisions. The conditions that allowed the Grizzly Gulch fire to spread rapidly through the crowns of the trees also exist in some locations of the analysis area. The conditions that allow a crown fire to occur include a relatively continuous conifer canopy, ladder fuels, steep topography and exposure to adverse weather conditions such as high winds, low humidity, and high temperatures.

Table 11 Fire Occurrence for FMZ 2

FIRE MANAGEMENT ZONE 2	
Fire class/size	**Average # fires/yr**
A, 0-1/4 ac	20
B, ¼-10 ac	11
C, 11-100 ac	< 1
D, 111-300 ac	<1
E, 300-1000 ac	<1
F, 1000 + ac	<1

As summarized in the Black Hills NF National Fire Management Analysis System (NFMAS)
Updated to include 2002 large fires.

The software program PROBACRE was utilized to assess the risk of wildfire occurrence from a single or series of wildfire events. It calculates the probability of a major single event, or multiple fire events and the long-term probability that a combination of fire events, both large and small, would result in a total burned area in excess of a particular number. All probabilities are calculated from information on annual frequency of fires by size class of concern.

PROBACRE INPUTS

Fire frequency input is from the Black Hills NFMAS historic fire table. It is expressed as annual fires/year. The period for the historical fire records is 1970 to 1996. This corresponds to the period where the records have been edited and are accurate. Large fires from 2002 were added to reflect up to date information. Fire probabilities are based upon the conditions that existed during the historical analysis period and represent a range of conditions. Those conditions, which include weather factors, may or may not be present for the projected time period.

PROBACRE RESULTS

The PROBACRE analysis was conducted for Fire Management Zone 2 (FMZ 02), period length was 10 years.

Table 12 Fire Management Zone 2

SIZE CLASS	FIRE FREQUENCY		PROBABILITY OF NUMBER OF FIRES PER PERIOD					
	ANNUAL	PERIOD	NONE	1	2	3	4	>4
10	31	310	0.0	0.0	0.0	0.0	0.0	1.0
100	.79	7.9	.0004	.0029	.0116	.0304	.0601	.8946
500	.12	1.2	.3011	.3614	.2169	.0868	.0260	.0078
1,000	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0
3,000	.030	.30	.7408	.2222	.0333	.0033	.0003	0.0
10,000	.030	.30	.7408	.2222	.0333	.0033	.0003	0.0
PROBABILITY OF EXCEEDING	10	ACRE THRESHOLD IN	10	YEARS IS	1.00000			
PROBABILITY OF EXCEEDING	100	ACRE THRESHOLD IN	10	YEARS IS	1.00000			
PROBABILITY OF EXCEEDING	300	ACRE THRESHOLD IN	10	YEARS IS	1.00000			
PROBABILITY OF EXCEEDING	1,000	ACRE THRESHOLD IN	10	YEARS IS	1.00000			
PROBABILITY OF EXCEEDING	5,000	ACRE THRESHOLD IN	10	YEARS IS	.5616			
PROBABILITY OF EXCEEDING	10,000	ACRE THRESHOLD IN	10	YEARS IS	.2813			

Values at risk

Values help establish fuel treatment priorities. According to the Black Hills Fire prevention planning and workload analysis, the values at risk for this project include: Timber, water storage, scenic byways, residential development, fish and wildlife habitat, commercial development, visual resources, recreation, and cultural/historical concerns.

The report, "Protecting People and Sustaining Resources in Fire-adapted Ecosystems: a Cohesive Strategy to Reduce Over-Accumulated Vegetation," approved on October 13, 2000, establishes the following priorities:

Wildland-urban interface. Wildland-urban interface areas include those areas where flammable wildland fuels are adjacent to homes and communities.

Readily accessible municipal watersheds. Water is a critical resource in many western states. Watersheds impacted by uncharacteristic wildfire effects are less resilient to disturbance and unable to recover as quickly as those that remain within the range of ecological conditions characteristic of the fire regime under which they developed.

Threatened and endangered species habitat. The extent of recent fires demonstrates that in fire-adapted ecosystems few areas are isolated from wildfire. Dwindling habitat for many threatened and endangered species will eventually be impacted by wildland fire. The severity and extent of fire could eventually push declining populations beyond recovery.

Maintenance of existing low risk Condition Class 1 areas. It is recognized that in many cases, it is easier to maintain sites in low hazard conditions than it is to restore sites that are a high hazard.

There are several **Communities at Risk** (Fed. Reg., Volume 66, No. 166, *Urban Wildland Interface Communities within the Vicinity of Federal Lands that are at High Risk from Wildfire*, August 17, 2001) within or adjacent to the project area. These Communities include Boulder Canyon, Sturgis, Galena, Lead and Deadwood. Wildland/Urban Interface areas are increasing within the project area. This expansion will continue as more and more private in-holdings are subdivided and developed. Currently there are in excess of 500 homes, outbuildings, and cabins within or directly adjacent to the project boundary. In addition, there are approximately 250 additional structures within one mile of the project boundary. These structures are located throughout the project area. Any project level fire within the Elk Bugs and Fuels analysis area would require structure protection of at least some of the residences on any given day, depending on the direction of fire spread.

Managing risk to Communities

Research by Jack Cohen (1999) has shown that structures with typical ignition characteristics (wood sided, wood framed, asphalt composition roof) are at risk of catching on fire from one of three sources. The first is direct exposure to intense flames from a nearby source, which could be intensely burning vegetation or another structure. His research shows that the structures may be at risk if the flame front is less than approximately 100 feet away. Structures may also be ignited from less intense sources against or close to the side of the structure. This can occur if firewood or other flammable material next to the structure is ignited by a ground fire or firebrands. In addition, firebrands falling directly on roofs can ignite the structure if the roof is flammable, or if flammable debris is present.

An important difference between the behaviors of fires in urban areas from those in wildlands is that structures, homes, garages, and other buildings, are part of the fuel conditions. Research by Dr. Cohen and others have provided information on how structures catch on fire, and how once on fire they contribute to the spread of the fire. Once a structure ignites, the fire can spread to other nearby structures, sometimes without igniting the surrounding vegetation.

Fuel treatments around and within communities are performed to reduce fire hazard, and thus reduce the potential damage to community resources and increase the safety of the public and of firefighters, should a fire occur. Fires burning through a community can damage and destroy homes and other structures, and damage other public and private property, such as vehicles, urban trees and shrubs. The goals of Wildland/Urban interface treatments are to reducing flammability reduce fire intensity, reduce the potential for creating firebrands and crown fires, and increasing firefighter safety and effectiveness.

In order to effectively protect a community located in a high fire hazard environment, it is desirable to perform fuel treatment projects at a range of distances from homes. Treatments at some distance from the developed portion of a community (a few to several miles) can reduce the direct risk to the community when conditions that support the initiation and spread of crown fires that can reach the community are managed, or where a large or intense fire may cause indirect damage to the community (such as a water source or erosion hazard).

Treatments near developed portions of a community (a hundred to thousands of feet from structures, for example) can add to the protection of the community infrastructure and local environmental resources. They can increase the safety of escape routes for residents and access routes from firefighters. Reducing spotting potential and the production of fire brands from this zone can reduce the risk to structures, although spotting can occur over much longer distances when burning intensity is high. It is generally true however, that the greater distance that a given point is from a fire, the less pronounced spot fires at that location become. If treatments are applied in areas to create or link areas which could act as firebreaks, they could be effective in some circumstances at allowing fires to be kept outside a community. For fires that might originate in or near these areas, treatments that are effective at reducing spread rates or decreasing resistance to control, can increase to opportunity for containing the fire before it damages structures.

Treatments of natural fuels within and around developed areas are not sufficient to insure protection of neighborhoods and individual, privately owned structures. Firebrands from crown fires may be carried long distances, and fires that start from firebrands in or immediately around homes can ignite structures. The construction details and the materials used in homes, the removal of flammable material on and adjacent to the homes, and the treatment of vegetation on the property itself is important to individual structure protection. Ideally, each homeowner would engage in this kind of protection for their homes, including inflammable roofs and other areas on which firebrands might collect and ignite flammable home materials.

Treatments that center on high value and strategic locations also make sense in managing fire spread across the landscape. Since treatment of every acre is improbable due to both ecologic and economic concerns, it is logical to concentrate the bulk of treatments in these locations.

There are 2 municipal watersheds within or the project area, the Fort Meade VA Hospital and city of Sturgis watershed. These watersheds that are on non-forest system lands have had some vegetative treatments done.

Desired Vegetative Conditions and Indicators

The desired condition for the Elk Bugs and fuels project area would be to have well spaced trees without extensive ladder fuels in the pine stands. Stands in the area would have higher canopy base heights so that surface fires would not transition to crown fire at 90th percentile weather conditions. This would be represented by Torching Indexes of greater than 15-20 MPH. Torching Index is the open (20 ft.) wind speed at which crown fire activity can initiate for the specified fire environment. The torching Index is most useful as a comparison of the fuel "ladder" between surface fires and the canopy of the forest. Canopy bulk density would be less than that required to sustain active crown fire spread under the same weather conditions. To reduce the susceptibility to running crown fires, crowning indexes should also be greater than 15-20 MPH. Crowning Index is the open wind speed at which active crowning is possible. The crowning index is useful to compare how easy it is to sustain a running crown fire.

Openings such as meadows would be larger and more prevalent than the current condition. Deciduous trees such as aspen, and birch would occupy more areas, which would serve as areas of less intense fire behavior under most conditions. Natural breaks in the fuel complex that are along strategic suppression locations would be increased to provide the opportunity to compartmentalize fires burning under more severe locations. Locations such as roads, trails and other strategic locations that have good access would be treated to provide an area of less flammability for fire suppression forces to conduct holding or burnout operations. These natural and constructed fuelbreaks would compliment area treatments to help suppression forces contain wildfires. Fuelbreaks are often confused with firebreaks, which are narrower and are cleared to bare mineral soil, with no attempt at vegetation conversion. A fuelbreak is defined as a strategically located, wide block or strip on which a cover of dense, heavy or flammable vegetation has been permanently changed to one of lower fuel volume and reduced flammability (Green 1977). Fuelbreaks are not intended to stop the headlong rush of a fast moving wildfire (Green 1977, Omi 1977). Some fires burn with such intensity and rate of spread that burn out operations cannot be safely conducted before the fire reaches the site. This is why they are considered to be one tool in that can be used in conjunction with vegetative treatments to achieve overall objectives (Omi 1997). Fuelbreaks are used to change the behavior of a fire entering the fuel-altered zone, and as anchor points for indirect attack on wildland fires (Agee et al 1993).

Desired fire behavior

The desired fire behavior would have rates of spread such that existing fire suppression forces are capable of successfully containing fires under the guidelines of the forest plan. Light fuels such as grass and pine litter favor rapid line construction as compared to heavy accumulations of dead and downed fuels and are therefore considered more desirable because they are less resistant to control. Flame lengths at the 90th percentile weather conditions would be 4 ft or less to ensure that hand crews can be effective in their suppression actions. While the surface fuels are important to this end, of more significance are the canopy fuels. Fires that burn in grass fuels spread quickly but go out quickly, and are more easily contained than intense surface or crown fires. Crown fires are often the most difficult to control, do the most ecological damage, and pose the most threat to firefighters and the general public. Torching and crowning trees are the most significant source of spotting during a wildfire. Therefore a desirable change in fire behavior is to limit the ability of a given wildfire to burn in the crowns of trees. Limiting crown fires offers firefighting forces the opportunity to take swift, effective suppression action, which increases the likelihood, that suppression objectives will be met.

Environmental Consequences:

Direct, Indirect and Cumulative Effects:

Proposed Treatments

Thinning from below would reduce the ladder fuels in ponderosa pine stands. The larger trees that remain on the site will be more resistant to fire due to decreased flame lengths from the removal of ladder fuels. The decreased density would be less likely to support running crown fires. Alternatives 2 and 4 generally reduce the density of the existing stands more than alternative 3. Stands that are at risk from mountain pine beetle epidemic will be thinned to a lower risk rating level. Stands that have high beetle mortality and retain dried needles are considered very flammable and can transition to crown fire more readily than live pine trees. After needle drop the hazard will be reduced but the ¼ inch and larger diameter class fuels will increase once the trees begin falling. The large amounts of these heavy fuels increase the resistance to control by suppression forces due to increased spotting, more heat and longer residence time. Production of fire line by suppression forces will also be significantly reduced. Increasing the likelihood that a fairly hot fire can spread into neighboring stands. These types of stands can be hazardous to suppression forces due to falling snags, and large amounts of material that is receptive to flying embers. Reducing the density of the stand, limiting ladder fuels, and reducing pine beetle mortality will result in less chance for a wildfire to escape initial attack and subsequently spread to the adjacent private lands.

Mechanical whole tree harvest removes much of the activity fuels, depositing them a central processing landings for treatment. Stands that have had whole tree harvesting treatments have a lower fuel hazard due to reduced 3-inch and less fuel, and reduced canopy density and ladder fuels. These cutting practices also create fuel conditions suitable for conducting low intensity prescribed burning. (1996 Black Hills Revised Land and Resource Management Plan EIS) Commercial harvested areas within the project area are proposed for whole tree harvesting.

Prescribed burning is planned within all the action alternatives. Prescribed fire management is designed to re-introduce low-intensity ground fires, an important disturbance process of the Black Hills ponderosa pine. The burns proposed for forested areas would be low intensity with the objective to reduce surface fuels, reduce ladder fuels by pruning lower branches and reduce the canopy fuels by killing some of the smaller trees. Mortality will be higher as the tree size decreases and will be variable. However in general mortality will be limited to 75 percent of 0-3’ class, 50 percent of the 3-5’ class, 20 percent of the 5-9 inch class, and less than 10 percent to the 9” diameter class. Following treatment, surface fire intensity would be less, and ladder fuels would be reduced. Some surface fuels will accumulate following treatment due to the dead trees falling and accumulating on the ground. However, these trees will not have a significant amount of fine fuels attached, and the resulting increase in fire intensity due to scattered jackpots of fuel will be offset by the overall reduction in fuel hazard. The scorching of the lower branches, and subsequent rising of the height to live crown base will help move the project area towards desired future condition of the forest plan by reducing ladder fuels.

Hardwoods are more susceptible to fire induced mortality but quickly re-sprout from existing roots, and often grow with increase vigor following burning. Burning can be expected to increase the amount of hardwoods in stands that currently have a mixed understory.

Burning in grasslands and meadows where pine seedlings are encroaching will kill a large percentage of these very small trees. Future fire behavior will be reduced by maintaining these areas as non-forested grasslands.

Shaded fuelbreaks in the action alternatives will significantly alter the expected fire behavior in areas that have both the small and large tree stocking reduced. The areas within the fuelbreaks that only remove the smaller trees will require more effort and suppression forces to contain a fire in those areas. Less flammable patches of hardwoods along the fuelbreaks would be favored by reducing the pine trees in and directly adjacent to the site.

Hardwood restoration treatments will reduce the amount of ponderosa pine within stands that contain a combination of pine and deciduous trees such as aspen, oak, and birch. In the black hills these species are considered less flammable than conifers. Following treatment, these sites that are dominated by hardwoods would be low fire hazard and very unlikely to support crown fire activity.

Bait and sanitize treatments would not significantly alter the fuel hazard rating for the entire stand, but would create openings within the stand that would significantly reduce the intensity of a crown fire burning through the stand. These openings would consist of 1/10 acre to several acres in size.

Patchcuts create habitat diversity within monocultures of young regenerating pine stands. Treatments include removing all trees within an area 2-10 acres within a given treatment stand. Patch cuts would equal approximately 25% of acreage within a given treatment stand, and would not exceed 30% of stand acreage. More than one patch cut may be created within a treatment stand. Treatment of residual slash in patch cuts would include one or more of the following applications: lop and scatter, pile and burn, prescribed burn.

Treatments that limit the mortality of pine trees by mountain pine beetle will reduce the fuel hazard of that stand. Alternatives that decrease the susceptibility of forested stands to attack by insects and disease will also decrease their susceptibility to wildfire (1996 Black Hills Revised Land and Resource Management Plan EIS). Disturbance forces such as fire and forest insects and disease are closely related and disturbance by one is often followed by another. Insects and disease contribute to increased amounts of dead fuel material in the forest, which in turn increases the intensity of wildfire. For this reason, any successful effort to control forest insects and disease is likely to have a corresponding effect in reducing the threat of wildfire. (Black Hills Revised Land and Resource Management Plan EIS, 1996).

Legislation

Public Law 107-206 authorized 8000 acres of thinning on National Forest System lands to reduce fire and mountain pine beetle hazard. 3372 acres of thinning will occur within the project boundary, these areas will be low fire hazard following completion of the treatments. Active Crown fire is not predicted to occur within these stands under 90th percentile weather conditions. These areas will be treated regardless of the chosen alternative, thus for the purposes of the analysis they are analyzed separately.

Barring an unforeseen act such as storm damage or wildfire. Not all stands in the project area have the data available to run FVS, but all types of treatments were represented in the sampled analysis. The stands proposed for treatment were examined and it was determined that the modeled stands represented a good cross section of all those stands. Therefore the assumption was made that mean values would be a good comparison of fire potential in the treated areas.

The effects of a potential fire to the existing condition (no action), and the action alternatives were determined by using the Forest Vegetation Simulator, Central Rockies variant, the Nexus fire behavior program and the RMRIS database. The existing condition was used for the no action alternative, although stand conditions will continue to change over time, the fuel complex within the stand is not likely to see major changes with the next 5-10 years, barring an unforeseen act such as storm damage or wildfire. Not all stands in the project area have the data available to run FVS, but all types of treatments were represented in the sampled analysis. The stands proposed for treatment were examined and it was determined that the modeled stands represented a good cross section of all those stands. Therefore the assumption was made that mean values would be a good comparison of fire potential in the treated areas.

After completion of the proposed treatments for any of the action alternatives, fire behavior is expected to be generally less intense due to lower crown fraction burned. In most cases the expected fire behavior is a surface fire with flame lengths less than 4 feet. Surface fuels will still resemble the current conditions, but the fuel "ladder" will be less and the canopy density will be lower. The results over time will be less intense wildfires with less spotting potential due to torching and crowning trees. Overall effects to the vegetation from a wildfire are expected to be less severe. The intensive treatment of natural and activity fuels near private property and along strategic locations such as fuelbreaks will lessen the intensity of a wildfire in these locations, which can increase the safety of firefighters working in these areas.

Surface, ladder and canopy fuels

The effect of the proposed alternatives to the fuel complex within the project area are an important gauge to understanding how fire suppression action will be impacted. Within the project area, surface fuels are not expected to change dramatically as the result of any of the alternatives. Slash that normally would be produced from commercial harvesting operations is to be yarded from the site. An increase in surface fuels is expected in areas that are non-commercially thinned because not all of the slash and stems in these areas will be disposed of. Slash that is left on site will be lopped and scattered to 18" or less. The most flammable aspect of the slash, the needles, are expected to drop from the branches within 3 years. Decomposition rates in the black hills normally reduce fuel hazard loading within harvested stands to pre-harvested levels within 7-10 years.

For each of the alternatives the changes in fire hazard rating was calculated to display the overall hazard to the project area. For this analysis alternative 4 had the greatest reduction in hazardous fuel ratings, followed by Alternative 2. Alternative 3 also reduced the fuel hazard ratings but to a lesser degree than 1 or 2. All of the action alternatives would have a less overall hazardous fuel rating than the no action alternative. Due to steep slopes and the type of treatment, some stands appear to have stayed at the same fuel hazard rating. This occurred in some stands with prescribed fire and non-commercial only thinning. In these areas access, cost and feasibility of commercial harvest was the limiting factor in the treatment prescription. Slope steepness cannot be changed and is important to determining the hazard rating of the stand. Although the stands are not moved to a lower rating, they will be at the low end of the class they are in. Non-commercial thinning and prescribed fire would both reduce the ladder fuels and raise the canopy bulk density of the stand, and therefore, it is assumed that the overall hazard to the stand is reduced. The exception is where large amounts of thinning slash is left in place, this has a temporary effect on fire behavior by increasing the intensity of a surface fire. This is however a short term effect, which will be offset by the afore mentioned changes to canopy fuels.

Table 13 Reduction of Fuel Hazard Ratings

REDUCTION OF FUEL HAZARD RATINGS				
	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4
HIGH	0 Ac	1885 Ac	1714 Ac	2191 Ac
MEDIUM	0 Ac	1904 Ac	1140 Ac	2020 Ac

In order to better understand how the changes in the fuel hazard rating will effect the project area, fire behavior and effects were calculated based upon inventoried stand data. Using the best available data, sample stands for each of the action alternatives were used to predict the amount of change to the project area based upon flame length, canopy base height, canopy bulk density, torching and crowning indexes, and fire type.

The surface fuels on most of the sites today can be expected to increase with the no action alternative, resulting in increasing fire hazard over time. Stands with non-commercial thinning treatments that do not remove the resulting slash are expected to produce surface fires that are more intense than the existing conditions, but this can be expected to lessen after 3 years due to needle drop. Decomposition rates in the black hills normally reduce fuel loading within harvested stands to pre-harvested levels within 7-10 years. Treatments such as lopping and scattering, crushing, piling and burning, jackpot/broadcast burning and fuel break construction are utilized as interim measures to accelerate decomposition, reduce fire line intensity and/or break up fuel continuity. Fuel treatment efforts are directed at modifying or reducing the amount of dead material less than 3 inches in diameter. Harvesting mechanics, such as whole tree harvesting, which remove the entire tree to a central processing location, significantly reduce the fuel hazard of a stand immediately following harvesting. This type of harvest has an immediate and significant effect in reducing wildfire rates of spread and intensity, which contributes to reduced resistance to fire-control operations. Stands with commercial treatment are planned to use this method of harvest.

Predicting the surface fire behavior of the treated stands requires assigning surface fuel parameters. National Fire Behavior Prediction System (Behave) Fuel models 2 and 9 were used for pre and post treatment conditions for stands with whole tree harvest. For stands that did not have whole tree harvest, fuel model 11 was used when enough slash was deposited to override the existing fuel model before treatment. The resulting predicted flame length average incorporated the crowns of burning trees when that type of fire was predicted. All of the action alternatives averaged approximately 4-foot flame lengths the stand they were treating. The no action alternative averaged 9 foot flame lengths for the same stands. Hand crews can be effective at containing wildfires with 4-foot flame lengths, at 9-foot flame lengths only mechanized equipment such as dozers and airtankers are effective on the head of the fire.

The change to "ladder" fuels was measured by the height to live canopy base. All of the action alternatives raise the canopy base height (CBH). The represented stands in

Alternatives 2 and 4 have a higher average CBH by approximately 16 feet over the no action alternative. Alternative 3 has a higher average by 13 feet over the no action alternative. This is a significant change over the existing condition. When compared to no action in alternative 1, the result is that a given wildfire burning under the same conditions would need to be approximately 60 percent hotter to transition to passive crown fire for alternative 3, and approximately 70 percent hotter for alternatives 2 and 4.

Canopy fuels are measured by their mass and arrangement. All the action alternatives reduced the canopy bulk density in the treated stands. The mean for the sample stands proposed for treatment was .049 kg/m^3 in alternative 1, .033 kg/m^3 for alternative 2, and 4, and .031 kg/m^3 for alternative 3. As a result of the raised canopy base height and reduced canopy bulk density, the required rate of spread for a surface fire to transition to a crown fire in alternative 3 is approximately 2.5 times that of the no action alternative. For alternatives 2 and 4, it is approximately 3 times the rate of spread in the no action alternative. This means that fires will have to be burning under more severe weather conditions to have the same fire behavior.

Table 14 Fuels and Fire Behavior Indicators

Average Values for Sample Stands:	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4
Canopy Base Height	15 FT	31 FT	28 FT	31 FT
Canopy Bulk Density	.049 KG/M^3	.033 KG/M^3	.031 KG/M^3	.033 KG/M^3
Torching Index	29 MPH	57 MPH	51 MPH	57 MPH
Crowning Index	49 MPH	64 MPH	54 MPH	65 MPH
Flame length	9 FT	5 FT	4 FT	5 FT

When the surface fuels, CBH, and CBD are examined within context of each other, meaningful fire behavior can be predicted. Fire behavior factors such as flame length and the type of fire (surface, passive, conditional, or active), are good measures of the potential difficulties that suppression resources will encounter on a wildfire.

Flame length and fire type are two important aspects of fire behavior because it determines what type of firefighting resources are needed, and what kind of resistance to control there will be. The predicted fire type for stands proposed for treatments were compared to the no action alternative to demonstrate the expected change from existing conditions. Alternatives 2 and 4 saw the greatest reduction in fire behavior predicted in stands with active crown fire currently predicted. 85% percent of these stands in both alternatives 2 and 4 were reduced from active crown fires to surface fires. In alternative

3, 75 percent of the stands were reduced to surface fire. For stands with passive crown fire predicted, the results were very similar for all the action alternatives, with 80 percent reduced to surface fire in alternative 2 and 4, and 79 percent reduced to surface fire in alternative 3.

Table 15 Percent of Post Treatment Fire type for Treated Units

ALTERNATIVE 1 (NO ACTION)	ALTERNATIVE 2			ALTERNATIVE 3			ALTERNATIVE 4		
Fire Type	Active	Passive	Surface	Active	Passive	Surface	Active	Passive	Surface
Active Crown	7%	7%	85%	7%	18%	75%	7%	7%	86%
Passive Crown	0	21%	80%	0	21%	79%	0	20%	80%
Surface	0	0	100%	0	0	100%	0	0	100%

The fire regime condition class can help identify the level of change to one or more of the following: fire size, intensity and severity, and landscape patterns. As such, the degree of departure from historical fire regimes resulting in alterations of key ecosystem components such as species composition, structural stage, stand age, and canopy closure can be understood. Comparison of the amount of land in each condition class is in the following table. Condition class is a fairly broad characterization, and allows for a range of stand structure and conditions within the class.

Table 16 Fire Regime Condition Class

FIRE REGIME CONDITION CLASS			
	CONDITION CLASS I	**CONDITION CLASS II**	**CONDITION CLASS III**
ALTERNATIVE 1	12,242 Ac	11,925 Ac	20,599 Ac
ALTERNATIVE 2	19,397 Ac	10,021 Ac	18,714 Ac
ALTERNATIVE 3	18,460 Ac	9,313 Ac	18,885 Ac
ALTERNATIVE 4	19,829 Ac	9,895 Ac	18,138 Ac

Alternative 4 had the greatest change in the number of acres moved to a less severe condition class, followed by alternative 2, and then alternative 3.

Overall, alternative 4 will have the lowest fuel hazard for all of the alternatives, followed by alternative 2, alternative 3, and finally alternative 4. Alternatives 2 and 4 also treat more acres in the vicinity of high values, therefore they would be considered to be higher priority acres. Of the remaining high hazard areas in the project area, 10,554 are assumed goshawk habitat that cannot be treated, 2630 acres are being treated under activities in public law 106-207 (see cumulative effects for resulting condition class). The rest tend to be small trees, or are fairly remote or isolated, and therefore are not proposed for treatment at this time.

Post treatment, there will still be fire ignitions, but the ability to manage them with immediate suppression will have increased due to less area exhibiting intense surface or crown fire behavior. Within 3 years of the non-commercial thinning, surface fire will drop significantly due to needle drop from slash. Within 7-10 years post treatment, surface fire is expected to reach previous levels due to decomposition of most of the remaining slash.

Air quality

National Ambient Air Quality Standards (NAAQSs) are established by the 1963 Clean Air Act and subsequent amendments. The Clean Air Act and amendments establish emission standards for stationary sources of emissions. Smoke from wildfires and prescribed fires have the potential to impact air quality. Airflow, including smoke, typically moves from west to east in the project area. Air quality and visibility in the Elk Bugs and Fuels analysis area is good to excellent, although some air degradation occurs temporarily from wildfires.

There are two federally designated class I air quality areas in the region: Wind Cave National Park located approximately 40 miles south of the project, and Badlands National Park located approximately 60 miles southeast of the project. Because it is temporary, smoke from wildfire or prescribed burning does not compromise Class I goals (BHNF Land and Resource Management Plan). Short-term impacts are possible however. Rapid City, South Dakota is located to the southeast of the project area and is designated by the EPA as a non-attainment area for PM-10.

There are numerous possible receptors within and adjacent to the project area such as roads, towns, subdivisions, and other air-quality sensitive areas, which are identified during the prescribed burning process. Burn prescriptions are developed to ensure that air quality standards are maintained in the receptor areas.

Direct and Indirect Effects

Alternative 1

Alternative 1 would have no direct or indirect effect to existing air quality.

Alternatives 2, 3, 4

All of the action alternatives include burning of brush piles and broadcast burn activities that produce smoke and would temporarily affect air quality. Prescribed burning is carried out in the fall, winter or spring when weather and fuel moisture conditions are conducive to meeting the objectives of the burn, mainly to reduce surface fuel loading and reduce density of tree stems, usually in the smaller diameter classes, to ultimately make the burned area more resilient to effects of a wildfire. Pile burning of debris is generally carried out with snow on the ground to minimize potential control problems.

The season in which burning takes place can effect smoke dispersal and therefore mitigate potential impacts. November through March have the highest probability for daytime inversions. Typically inversions are common during clear, calm, settled weather when warm air lies above the cool air surface layer. This condition traps smoke resulting in poor visibility and hazy conditions. Under poor dispersal conditions smoke can also be funneled down slope and toward lower elevations where most of the developed property is located, making smoke a public irritant.

The effects of burning slash piles and broadcast burning would be short term and dissipate within days or hours. Burning of slash piles would be done following harvest and piling, as necessary. Both PM10 and PM2.5 would be generated from pile burning. Material in the piles would be dry, allowing maximum consumption of all material. Lighting well-cured piles during the daytime with good venting conditions can maximize smoke dispersal, Limiting impacts downwind by minimizing smoldering, and reducing the amount of smoke moving down slope during the evening and nighttime. Drier fuels will also consume quicker, reducing residence time, thus reducing the particulate matter levels. Smoke produced is below the 150 micrograms per cubic meter (ug/m3) NAAQS standards of daily emissions.

Potential negative impacts from smoke can be eliminated if lofting heights are above 1000 ft and transport winds are not directly upwind of the receptor. Smoke concentrations will be greatest less than 4 miles from the burn area. PM10 production is not exceeded during fair to excellent stability and winds generally greater than 1 mph and less than 10 mph. Burning 60 landing piles a day under excellent to fair dispersal conditions only led to exceedences in very short distances, I.E. less than 2.5 miles. This is however for a concentrated area, and it is very unlikely that this number of piles would be located so close together. Burning fewer piles per day, burning with more wind, or burning under more favorable weather would reduce PM2.5 concentrations. In addition, burning will not occur when it will affect the Rapid City airshed while an air quality alert has been issued.

Table 17 Particulate Production

Particulate Size Class	NAAQS standard for 24 hr period	Max 6 hr particulate production
PM10	150 ug/m3	94 ug/m3
PM2.5	65 ug/m3	61 ug/m3

Smoke dispersion is a key consideration in any decision to implement prescribed burns. Broadcast burn plans prepared by the Black Hills National Forest are required to contain a smoke management prescription, based upon daytime and nighttime smoke dispersal. They specify lofting heights, and acceptable smoke dispersal directions. Igniting burns under fair-to-excellent ventilation conditions and suspending operations under poor smoke dispersion conditions; will reduce the potential for impacts to air quality. Smoke concentrations will be greatest less than 4 miles from the burn area. Modeling a typical broadcast burn in Ponderosa Pine produces PM 10 particulate matter well within the allowable daily emissions, assuming 250 acres per day. The amount of PM2.5 is slightly lower than daily allowable emissions. The model assumes consistent smoke production through out the burning period. The maximum amount of PM2.5 produced during the burn would be about 63 ug/m3. If larger areas are burned in a 24-hour period, adjustments to the smoke management plan will be needed.

Table 18 Typical Broadcast Burn Factors

Particulate Size Class	NAAQS standard for 24 hr period	Typical Broadcast burn: 250 acres/day
PM10	150 ug/m3	Max. 73 ug/m3
PM2.5	65 ug/m3	Max. 62 ug/m3

Alternative 2 has less broadcast burning and slightly less pile burning than alternatives 3 and 4. Due to the temporary nature of smoke, and the ability to control the amount of burning conducted in a 24-hour period, the differences in effects to air quality for all of the action alternatives will be minor. None of the alternatives would substantially change the existing air quality, nor would there be significant differences in the effects of the alternatives on air quality. Burning will be implemented on days when air quality degradation can be minimized, especially near Rapid City. By following appropriate smoke dispersal guidelines, smoke impacts from prescribed burning and pile burning should be short lived, local in extent and within acceptable limits.

Cumulative Effects

The past impact having the greatest effect on air quality was the Grizzly Gulch fire that burned over 11,000 acres in 2002. This had a large immediate effect on the air quality of the fire area, the District and beyond. Air quality issues associated with past activities have passed. Current activities such as pile and broadcast burning associated with timber sales, thinning and fuels reduction are coordinated on the district so that they do not act together to increase the effects.

Conclusion: Smoke production and emissions are within federal, state, and local air quality regulations. The proposed burning is of short duration, and following the appropriate guidelines, would not affect any non-attainment areas, and would not adversely affect Class I areas.

Cumulative Effects

The area analyzed for cumulative effects are the eighteen 7th order watersheds that encompass the project area and activities undertaken due to Public Law 106-107. Treatments adjacent to a given stand generally have little direct effect on fire hazard within that stand. However, treatments that limit the ability of a crown fire to burn from one stand to another can indirectly affect a stand if it is sufficiently close.

Past and Planned Treatments

The following table identifies forty-one timber sales within the Elk Bugs and Fuel project area since 1982. Timber harvest took place prior to 1982, but there are no records available. Table 52 shows the sale name and approximate years of harvest activity. Sales that are a result of recent legislation, Public Law 107-206 are not included. Salvage sales in the early 1980s harvested timber damaged during a snowstorm that occurred in 1982.

Table 19- Recent Timber Sales Within Elk Bugs and Fuel Project Area

Sale Name	Years of Harvest Activity	Sale Name	Years of Harvest Activity
Chicken	1982-1984	Tilford	1986-1993
Spring Run Salvage	1982-1983	Monument	1986
Polo Salvage	1982	Nasty	1986-1988
Hill Salvage	1983	Runkle	1986-1987
Rooster Salvage	1983	Kelly	1986-1990
Three Draws Salvage	1983	Dalton	1986
Virkula Salvage	1983	Hay	1989-1991
Tilford Salvage	1983	Lost	1989-1994
Pullet Salvage	1983	Pit Resale	1991-1992
Cave Salvage	1984	Cave	1992-1996
Crook Mountain Salvage	1984	Vanocker	1994-2000
Left Salvage	1984	Roost	1994-1997
Lost Salvage	1984	Boomer	1997-2000
Park Creek Salvage	1985-1987	Deadman	1997-2001
Pigtail Salvage	1985-1986	Kirk	1998-2000
Red Hill	1985-1987	Pit	1998
Kirk Hill	1985	Piedmont	1999-2000
Pine	1985	Boulder	2001-2002
Polo	1985	Redhill	2002
Chicken Bugs	1985	Roubaix	2002
Sid Bugs	1985		

These actions will have thinned the density of the affected stands, reducing fire hazard. Due to the prolific regeneration of ponderosa pine in the black hills, these stands start moving towards a more hazardous condition class following treatment. The length of time between the last disturbance, regardless of cause, is directly related to how close those stands are to moving back to a more hazardous condition class. The Fuels in the stands previously treated by past timber sales within the project area do not pose a significant threat to those stands adjacent to them due to the reduction in stand density.

The following Table 53 lists the acres of vegetation treated in timber sales in the 1980s, 1990s, 2000s, and recently planned timber sales. The resulting condition class is given for each activity. This table does not include treatments planned and implemented under recent legislation, P.L. 107-206.

Table 20 - Acres of Vegetation Treatment; 1980s - Planned (RMRIS data)

Resulting Condition Class	Treatment Description	1980s	1990s	2000s	Planned
1	Clearcut	182	239	32	76
2	Shelterwood preparation	0	0	90	0
1	Shelterwood Seedcut	646	1749	100	188

Resulting Condition Class	Treatment Description	1980s	1990s	2000s	Planned
2	Shelterwood removal and overstory removal	143	629	45	307
2	Uneven-aged management – group selection	0	0	0	16
2	Thin	8,840	3,634	51	7
2	Salvage	1,700	0	0	0
1	Special cut (aspen, aspen/birch maintenance and enhancement	0	0	50	58
2	TSI – Precommercial thinning	1,344	2,144	218	74
1	Habitat improvement - tree encroachment control	0	0	13	264
1	Regenerate aspen – clearcut	458	356	7	54
1	Tree encroachment control	0	321	40	103
	Total Acres Treated by Decade (% of Forested Area)	13,313 (28%)	9,072 (19%)	646 (1%)	1,147 (2%)

Condition class was assigned based upon the type of disturbance the stand received, however, due to the exclusion of fire since the disturbance, treatments conducted during the 1980's are moving toward a more severe condition class.

Current Actions

There are approximately 3372 acres of harvest activity and fuel breaks planned within the project boundary under the recent legislation P.L. 107-206. The treatments are expected to occur within the next 5 years. These activities will result in less hazardous conditions in the project area. Crown fire is not predicted to occur in these stands under 90th percentile weather conditions. Using the parameters established for this project, condition class in these sites will move to class 1. These treatments will further reduce the threat of large crown fires in the project area.

Timber sales that are currently ongoing in the project area are the boulder, Danno, Kirk, Piedmont, Redhill, and Cavern. These sales can be expected to reduce the stand density in the harvest units, resulting in less hazardous conditions.

Wildland /Urban Interface areas are likely to increase due to the continued development of privately owned property in the project area. It is foreseeable that some small scale fuel reduction activities will occur on these lands as the result of clearing for home sites and continuing education of homeowners by local, state and federal fire management agencies. These areas will assist fire suppression activities in the area, mostly by providing additional defensive space for firefighters working adjacent to homes.

Cumulative Effects

Based upon the proposed alternatives, following the implementation of treatments that are a result of public law 106-207, and the impacts of the preceding management actions, a summary of the cumulative effects are displayed through the projected condition class of the project area in Table 54.

Table 21 Fire Regime Condition Class

	CONDITION CLASS I	CONDITION CLASS II	CONDITION CLASS III
ALTERNATIVE 1	12,242 Ac	11,925 Ac	20,599 Ac
ALTERNATIVE 2	19,397 Ac	9,285 Ac	16,084 Ac
ALTERNATIVE 3	18,460 Ac	10,049 Ac	16,255 Ac
ALTERNATIVE 4	19,829 Ac	9,159 Ac	15,778 Ac

Connectivity to other areas

Outside of the project area the cumulative effects area includes 45,642 acres of National Forest System lands and 6,124 acres of other ownership. Included in the analysis is Beaver Park and the surrounding area and the additional 5 watersheds, which contain the activities undertaken due to Public Law 107-206.

Most of the wildfires in the area have been relatively small, inducing little mortality in the overstory, but reducing surface fuels in the short term. Several large fires have occurred in the project area however. The Lost gulch fire in 1931 burned 402 acres. The Big elk fire burned 1576 acres within the project boundary and the cumulative effects area in 1949. The 1959 Deadwood fire burned only a small portion of its 4547 acres within the project area but approximately ¼ or the fire was within the cumulative effects watersheds for the project. These fires had more severe effects and evidence of these burns still exists today. The heavy mortality in the Big Elk burn was replanted in the 1950's and has resulted in dense stands of relatively small trees. The Little Elk fire of 2002 burned 484 acres of private and national forest system lands. Mortality was mixed but generally low the National forest system lands, however about ½ of the intensely burned area on private land has been harvested.

The Grizzly Gulch fire of 2002 burned approximately 11,589 acres and was immediately adjacent to the northwest portion of the project area. It also burned approximately 5,608 acres of the project area, 3025 of which were on National Forest System Lands. The majority of the acres within and adjacent to the project area burned with relatively low intensity, which resulted in less surface fuels and higher crown base heights due to mortality to smaller trees, and pruning of lower branches of larger trees. Approximately 240 acres burned with high mortality. As a result, the area immediately to the northwest of the project is relatively safe from intense wildfires in the next 10 years. It also makes it unlikely that an intense wildfire will enter the project area from the area burned in the Grizzly Gulch fire.

There are approximately 4,628 acres of treatment planned and or ongoing adjacent to the project area under the recent legislation P.L. 107-206. There is currently 700 acres of non-commercial treatment occurring in the Forbes Gulch area and an additional 117 acres of fuel breaks along the boundaries of Beaver Park. These treatments are ongoing and expected to be completed within the next 2 years. These activities will result in less hazardous conditions in the project area. Crown fire is not predicted to occur in these stands under 90th percentile weather conditions. Using the parameters established for this project, condition class in these sites will move to class 1. These treatments will further reduce the threat of large crown fires in the project area by reducing the likelihood that a fire originating in these areas could burn into the project area.

Other past actions in the project area include timber harvest, silvicultural management such as thinning, fuels management and wildfire suppression, grazing, mining, recreation, wildland/Urban interface development, utility line development, wildlife management, and road construction.

Timber harvest has occurred since the early 1890's in the area, but formal record of the exact locations does not exist for harvest before 1980. The following Table contains the recent timber sales within the cumulative effects area.

Table 22 Recent Timber Sales within the Cumulative Effects Area

Sale Name	Years of Harvest Activity	Sale Name	Years of Harvest Activity
Benchmark	1979-1986	Hay	1989-1991
Stagebarn	1981-1989	Lucky	1989-1993
Airport Salvage	1982	Novak	1991-1993
Greenwood	1982	Pit resale	1991-1992
LS Salvage	1984	Greenmont	1991
Wilson Salvage	1984	Cave	1992

Erskine	1985	Flagstaff	1992-1993
Lucky East bugs	1985	Dump	1993
Lucky west bugs	1985	Greenwood	1997
Dalton	1986-1993	Bench	1997
Kelly	1986-1990	Kine	1997-1998
Skislide	1988-1991	Kirk	1998-present
Wilson	1988	Cavern	1999-present
Misty	1989-1990	Public Law 107-206 Sales	2002-present

The following 56 lists the acres of vegetation treatment in timber sales on National Forest System Lands since the 1980's, planned timber sales, and treatments planned under public law 107-206. The resulting condition class and acres relative to the action are included.

Table 23 Past, Present and Foreseeable Timber Sales

Resulting Condition Class	Treatment Description	1980s	1990s	2000s	Planned	Total Acres
1	Clearcut	182	239	32	76	529
2	Shelterwood preparation	0	0	90	0	90
1	Shelterwood Seedcut	646	1749	100	188	2683
2	Shelterwood removal and overstory removal	143	629	45	307	1124
2	Uneven-aged management – group selection	0	0	0	16	16
2	Thin	8,840	3,634	51	7	12532
2	Salvage	1,700	0	0	0	1700
1	Special cut (aspen, aspen/birch maintenance and enhancement	0	0	50	58	108
2	TSI – Precommercial thinning	1,344	2,144	218	74	3780
1	Habitat improvement - tree encroachment control	0	0	13	264	277

1	Regenerate aspen – clearcut	458	356	7	54	875
1	Tree encroachment control	0	321	40	103	464
1	Forbes Gulch Fuel Treatments				700	700
1	Beaver Park -Forest Boundary Fuel Break				117	117
	Total Acres Treated by Decade (% of Forested Area)	13,313 (28%)	9,072 (19%)	646 (1%)	1,147 (2%)	

Current timber sales on National Forest system lands outside the project area but within the cumulative effects area include Kirk, Cavern, and sales as a result of Public Law 107-206. Wildfires are aggressively suppressed. Maintenance of developments continues, as does grazing and recreational activities. Some small-scale treatment of fuels within private property is occurring on a limited basis.

This project is in the vicinity of fuel reduction projects being conducted by the BLM, city of Lead, and private landowners in the exemption area north and west of the project area. Fuelbreaks, thinning and prescribed burning that are planned by the BLM for the exemption area such as the treatments and fuelbreaks being conducted adjacent to residences near Lead will reduce the likelihood of fire entering the project area from that direction.

Future Actions

Foreseeable action include continued development in the Wildland/Urban Interface, wildfire suppression and fuels management, recreation activities, wildlife management, livestock grazing, road maintenance, and vegetation management. Planned timber sales that include harvest fuels management, and non-commercial vegetation management Include Jimmy and Strike, which are scheduled for 2004.

Effects from Future Actions

Historically, the frequency of fire in these areas was sufficient to control the fuels and vegetative structure in such a way that large, stand-replacing fires would be quite rare. However, even in low severity fire regimes, intense fires may sometimes occur, possibly due to longer than normal fire-return intervals that allow litter and understory fuels to build up, or due to very unusual fire weather. In most instances however, frequent fire will act as a natural thinning agent to keep fuel conditions from reaching a level where crown fires are likely. Surface fires helped to kill the younger, weaker trees and dense thickets in a young pine stand, as a result competition and stand stagnation were minimized. Lower branches and foliage of the remaining small trees were pruned and thinned. Repeated fires permitted the development of mature ponderosa pines with expanded canopies, sometimes nearly closed.

Most of the wildfires in the area have been relatively small, inducing little mortality in the overstory, but reducing surface fuels in the short term. Several large fires have occurred in and adjacent to project area however. The Big elk fire burned 1576 acres within the project boundary and the cumulative effects area in 1949. The 1959 Deadwood fire burned only a small portion of its 4547 acres within the project area but approximately ¼ or the fire was within the cumulative effects watersheds for the project. These fires had more severe effects and evidence of these burns still exists today. The heavy mortality in the Big Elk burn was replanted in the 1950's and has resulted in dense stands of relatively small trees.

The vegetation in the effects area has been altered from pre-settlement conditions through timber harvest, fire suppression, mining, grazing and wildfires. Relatively dense stands of ponderosa pine dominate the area, with small areas of aspen, birch and oak. Timber harvest has thinned stands, but growth and regeneration of small trees has exceeded the rate of harvest. Most of the stands are similar-age class and fairly dense. More of the area is covered with stands of pine, which are more dense and smaller diameter than historically. Grasslands, aspen and hardwood stands occupy less area.

Recreation in the area has had little effect on fuels management, although roads, trails and corridors will break up the continuity of the canopy to a small extent.

Development of private property within the area will continue. It is likely that some small scale fuel reduction activities will occur on these lands as the result of clearing for home sites and continuing education of homeowners by local, state and federal fire management agencies. These areas will assist fire suppression activities in the area, mostly by providing additional defensive space for firefighters working adjacent to homes.